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AUTHOR Russell, Howard
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ABSTRACT

Replication of the Second International Mathematics Study (SIMS) in Ontario, Canada, is described and assessed. The curriculum and testing program covers numerical methods, geometry, and algebra. Whereas classical studies focused on mean scores of a system's students and on percentages of teachers for opportunity to learn (OTL), SIMS aggregates student scores as attained coverage indices and these indices are nothing more than classical p-values. The SIMS approach aggregates OTL data into implemented coverage indices that are grounded in the same test items as attained coverage indices or p-values. The SIMS methodology also involves an intended coverage, which in the past has been labelled the approved curriculum. Results from various school boards and regions--Halton, North York, Scarborough, York, Durham, Carleton, East Parry Sound, Grey, Peel, and Halton Roman Catholic School Board--are discussed. Focus is on data for Halton, York, and Carleton. In Ontario, a fundamental shift from a focus on individual student differences in total scores to a new focus on group proportions of success on particular items is currently well underway but is not yet complete. SIMS replications identify some of the realities of changes that are possible when the right sorts of data are gathered and analyzed at a level that is close to the school and school members. The second generation of SIMS replications is currently underway. Four data tables and a flowchart model for the cyclic renewal/revision of a mathematics curriculum are provided. (TJH)

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AERA PAPER

SIMS REPLICATIONS IN ONTARIO

BACKGROUND

H. Russell

The Province of Ontario was ready for the Second International Mathematics Study when it was proposed in 1975 and it was ready for SIMS replications for curriculum monitoring as well. There had been the usual type of criticism of Ontario schools and Ontario students: namely that neither were performing very well. There was a widespread feeling that the 1967 abandonment of the last province-wide testing programme had lead to chaos in educational standards. Furthermore there was growing feeling that the official curriculum was not at all well implemented in the schools. It was natural then that when Roy Phillips and later Ken Travers explained the purposes of SIMS to Ontario leaders there was a strong positive response. It was strong and positive because Ontario needed answers to questions about how its official curriculum compared with official curricula in other countries, and how its official content faired in its transfer from the government mandate to the practicality of classroom presentations by teachers. Furthermore it needed to know how much of that content was actually learned by how many students in which places. These were some of the questions SIMS would answer.

There is more to the story however, and it makes the entry of Ontario into SIMS especially relevant. The virtual absence of province-wide data on student performance was creating a situation in which the Government would be compelled by public opinion to return to province-wide achievement testing, as was happening in sister provinces, or else some other alternative would be adopted that would provide answers to the most pressing problems. Sample survey technology had been emerging in a number of local school system evaluations and the provincial government was studying both NAEP and APU as models which would be useful at the provincial level. In fact about the same time that Ontario agreed to participate in SIMS it also mandated the development of the

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Ontario Assessment Instrument Pool which was a crossbreed of NAEP, APU and SIMS. It paralleled NAEP in that anonymous sample surveys were the means of gathering data. It paralleled NAEP as well in the committment to compare data over time. It parallelled APU in its commitment to create survey instruments that project the intricacies of subject content and process. It parallelled SIMS in its commitment to relate the student performance data to the opportunity-to-learn data. But most importantly the OAIP rhetoric and the SIMS rationale as well, called for changes in the curriculum that were clearly indicated to be needed by the new variety of survey data. Province wide changes would be indicated by province-wide data, system changes would depend on system data, and classroom changes would depend on classroom data. Thus the regional replications of SIMS in Ontario were in a very real sense a part of the original planning for SIMS.

The Ontario setting then was especially suited to SIMS and to SIMS replications. A number of school systems had already introduced sample survey techniques for programme evaluations in geography, history, mathematics as well as some other subjects. Also there was sufficient experience with this mode of evaluation that it was well understood by all participants that a major collaborative effort was required just to get a pool of items together that looked like the right substance, i.e., the content and the process of the objectives of the target curriculum. Thus both SIMS and OAIP were welcomed if for no other reason than that they provided the much valued survey instruments.

CONTEXT

A number of boards of education in Ontario have introduced SIMS replications and these boards are distributed over all parts of the province. The boards are Halton, North York, Scarborough, York, Durham, Carleton, East Parry Sound, Grey, Peel, and Halton RCSSB and in nearly all cases their reports are publicly available. The present

paper is based on these reports and on presentations made by the mathematics coordinators at a meeting especially planned for the purpose of reporting SIMS replications in Ontario. In virtually all cases these boards had had some experience with sample surveys focussed on curriculum practice.

The introduction of sample survey evaluation techniques is difficult to arrange when teachers and school officials are accustomed to classical testing that involves all students doing all the questions. But SIMS replications introduces other problems as well. The test items in the SIMS replications have already been "used" beforehand, and they are in the public domain. This does not seem reasonable to educators because they have difficulty imagining the testing of the curriculum without testing the students, the teachers, and the schools. The problem is compounded even further when educators consider whether or not their students would be willing to work at the test items without the usual reward or punishment motivation. Needless to state there was evidence of these problems in the cases eported below but there is evidence as well that they have been overcome.

The Halton system began to use sample surveys for curriculum evaluation in 1973 when a pool of geography items was developed for the Halton curriculum. The first issue that surfaced in this setting was that of student and teacher anonymity. Teachers in particular were anxious to ensure that there would be no indiviual teacher comparisons resulting from the enterprise. They seemed to be the first to understand the connection between annonymity and the validity of the data. It was no surprise then to find that school trustees had some trouble with the plan also but their trouble was that they they wanted to be able to make the comparisons that the teachers wanted to avoid. When the trustees realized that such a use of the data would inevitably lead to invalidation of the data they were persuaded to stop pressing for school comparisons, teacher comparisons, and student comparisons with the curriculum survey data. The other schools systems involved in the sample surveys had similar experiences and in most cases these ex-

periences preceeded the SIMS replication. As a consequence of such experiences the Ontario Teachers Federation had studied the issues and had expressed a favourable view of the anonymous sample survey mechanism for curriculum evaluation. The Ontario Association of Education Administration Officials made a similar study with a similar result, and as a consequence the teachers and administrators of the province were in a position to have some confidence in participating in such ventures. The trustees were not so throughly briefed but there seemed to be a sufficient number of them who were knowledgeable about the issues that no major problems emerged. It is probably reasonable to infer that all three groups, teachers, administrators and trustees were attracted by the comparisons with other countries and as well they all seemed to sense that there was a novel mechanism here which could be used to monitor the curricula for the schools.

Purpose Statements

The purpose statements for the North York replication were:

- To assess mathematics achievement in North York compared to the province.
- To assist in the evaluation of ongoing staff development programs using the grade 8 results.
- To assist in the evaluation of the new guideline programs (OAC'S) using the grade 13 results.
- To provide direction for future curriculum and staff development.

These purposes can be achieved in many different ways and the SIMS replication is just one of them. The potential for international comparisons, although not explicit, was unique to SIMS and that unique feature was surely a strong force in the decision to proceed.

The Durham purpose statement was even more general than the North York statements but it is significant in the sense that it signals program evaluation and not student evaluation. Thus Durham is on record as having the intent of the study to be "a system wide program evaluation" with some school/class implications.

The York Region Board of Education tied its purposes directly to those of the main SIMS study. It indicated that the purpose of SIMS was to collect information about the teaching and learning of mathematics in different nations around the world, and it stated that what they were doing was a replication of SIMS. It is clear that their intention was to replicate SIMS in as many ways as possible, and in particular to provide international comparisons.

The Carleton Board of Education included its purpose statements in the text under the heading "Introduction." The second paragraph tells the story.

> "The Trustees want to know, for example, to what extent teachers are teaching what they are supposed to be teaching, what variations there are between schools in the taught curriculum and in evaluation practices and how an education in Carleton compares with other comparable boards, and indeed with the world. . ." and in the next paragraph "A replication of SIMS in the Carleton Board on an every-student basis was most welcome since the project promised to satisfy everyone of the needs described above."

The wording of this document is revealing on the point of program evaluation versus student evaluation. There is built in assurance of anonymity and the comparisons suggested seem to imply there would be some spilling over from the program comparisons to the domain of people comparisons. That is the point on which the reluctance of teachers begins to show and it is important to note that this reluctance was noted by the authors of the Carleton Report.

The purposes of the remaining boards for undertaking SIMS replications are similar to those given as illustrations. Indeed there are variations among boards as to their purposes in participating but it is clear enough that they possess one element in common, namely a willingness to document the three curricula, intended, implemented and attained, and a commitment to change curricula where the data indicate a need for change.

The Data and Change

The rhetoric for change within SIMS and in particular within the replications seems to vary from one board to another and the rules governing the decisions to change are idiosyncratic as well. The Halton situation was the first one to be documented and it is instructive. In essence there was a rough comparison of student attainment and opportunity-to-learn and the assumption here was that some of the lack of performance by students could be attributed to lack of opportunity-to-learn. Needless to state there was no clear definition of "lack of performance" and no clear definition of "lack of opportunity-to-learn." There were intuitions however and there was dialogue. There was dialogue among teachers. There was dialogue among officials and there was dialogue among trustees. Also there was some dialogue among the three groups, and in some important respects such dialogue lead to a consensus view on action needed.

The data base for these deliberations in Halton includes both OTL and p-values for both Pop A and Pop B. Retentivity data and other data were gathered as well. Table 1 is taken from the Halton Report. The first observation was that the Halton system seemed to provide superior service at the elementary grades as evidenced by the higher than average $\tilde{p}$. The next observation was that the advantage had disappeared through the secondary years because the Pop B $\tilde{p}$ (not shown here) was equal to that of the province as a whole. This was a very critical stage for Halton and it is true that the other boards went through this stage as well. In a sense the reaction to the data was similar to classical evaluations. The focus of attention was on the grand mean and when that grand mean was lower than expected then something had to be done. That "something" is usually to plead with or force people to work harder. But the Halton dialogue proceeded beyond this stage and made more sense of the data.

The data that were needed for the more comprehensive interpretation were the retentivity data. Past IEA studies have reported the relevance of such data and in the Halton case the retention data gave a very satisfying explanation for the attainment

Table 1: Halton Pop A Data

Classification of items on which Halton grade 8 student p-scores were less than 0.5.

TOPIC	Item Number	Halton p-score %	% of Halton teachers who teach item	Type I	Type II	Ontario p-score %	U.S.A. p-score %	Japan p-score %
Whole Numbers	105	14	89		x	14	22	50
	74	45	30	x		39	37	42
Common Fractions	76	35	98		x	31	33	32
	43	38	94		x	32	37	58
	78	33	92		x	22	21	39
Decimals	45	41	87		x	37	31	38
	182	47	100		x	36	62	n/a
	136	18	35		x	21	16	33
	168	18	62	x		16	10	35
Measurement	166	31	78		x	20	17	53
	40	33	79		x	31	29	79
	37	36	95		x	35	25	49
	133	46	100		x	48	39	75
Ratio & Proportion	142	26	62	x		19	22	51
	180	31	97		x	24	23	n/a
Per Cent	191	15	95		x	15	17	n/a
Representation of Data	129	21	50	x		19	16	41
Estimation & Approximation	45	41	87		x	37	31	38
	102	46	92		x	43	33	77
	59	22	76		x	18	16	53
	125	49	25	x		27	31	27
	123	31	93		x	28	22	47
	25	37	79		x	31	19	50
Plane Figures	58	41	90		x	33	35	59
	128	41	87		x	37	31	64
	24	44	85		x	45	45	75
	23	46	27	x		43	33	76
	21	49	95		x	39	37	52
	29	25	35	x		21	24	34
Coordinate Geometry	169	34	52	x		30	34	28
	175	46	87		x	37	30	31
	126	48	45	x		33	38	68
	169	34	52	x		30	34	28
Informal Transformations	63	42	63	x		32	25	58
	127	44	71	x		41	33	52
	15	32	76		x	18	29	74
Formulae & Algebraic	16	34	34	x		25	32	62
Expressions	148	35	42	x		32	36	59
	116	44	74	x		37	40	47
	151	20	71	x		12	21	58
Equations & Inequalities	87	22	97		x	22	18	36
	118	44	56	x		38	16	48

data. The R for Halton Pop B turned out to be .27 whereas the province at large was .19. This was satisfying because it indicated that the Halton secondary schools had arranged their promotion standards so that all Halton students who had attained a standard common across the province would be educated at the Pop B level. The alternative that was avoided was that the superior performance of the Halton schools would be maintained through Pop B but at the expense of students who would be restricted from entry into Halton's Pop B due to low marks or low attainment. The dialogue on this point was very revealing and it annoyed some of the vigorous advocates of high standards. But what came out of the dialogue was some understanding that Ontario had produced an unusually high retentivity and that Halton had surpassed the province on that scale. Also, it was evident that high retentivity when coupled with reasonable attainment produces high yield or a high level of delivery of mathematics education service.

The focus of attention of the Halton people moved on once again when the retentivity issue had been resolved. It shifted to what was not learned and what was not taught. In some critical instances, these turned out to be the same topics and items. There were some laughs when it was discovered that students did not learn what they were not taught, and vice versa to a lesser extent. But it was the low OTL and low attainment that gave the first indication of what could be done in the way of curriculum change that would have some reasonable prospects of success. The rhetoric was clear. If the students failed to learn something well defined because it was not taught, then what was needed to be done was to teach it. The tables show the topics requiring such attention and from there on the Halton SIMS Replication had a curriculum change rationale that seemed to be fundamentally sound. Other boards would follow.

The York Region data are presented in the form of their report in Tables 2 and 3. There is an added dimension of meaning in this presentation and it results from the inclusion of pretreatment data. The topic that is revealed as the lowest in student attain-

ment is "co-ordinates" in the geometry section. It is low for both the York Region students and for the province at large, and in each case it appears to be low because the OTL is low. The evidence from the pretest is important in this case because it suggests that attainment is improved in those situations for which instruction is provided. This latter piece of information gives added weight to the plausibility of the hypothesis that geometry performance can be improved if more students are taught geometry.

Table 2: York Region Implemented Curriculum, C_T
(Teacher Opportunity-To-Learn Questionnaire)

Subset	Average % of Items Taught in Grade 8 or Assumed Taught Earlier	
	York Region (1985 - 86)	Ontario (1981 - 82)
Numerical Methods		
Estimation & Approximation	92	87
Whole Numbers	85	82
Common Fractions	98	96
Decimal Fractions	96	93
Ratio & Proportion	89	84
Per Cent	96	95
Representation of Data	65	56
Measurement (Computation)	89	89
Measurement (Other than computation)	85	80
Geometry		
Plane Figures	72	67
Coordinates	55	56
Informal Transformations	51	42
Algebra		
Integers	87	92
Formulas & Algebraic Expressions	69	68
Equations & Inequalities	78	81

Table 3: York Region Attained Curriculum C_A
(Achievement Test Results)

	Average % Correct			
	York Region (1985 - 86)		Ontario (1981 - 82)	
Subset	Pretest	Posttest	Pretest	Postest
Numerical Methods				
Estimation & Approximation	56	65	52	60
Whole Numbers	63	65	60	61
Common Fractions	48	58	51	57
Decimal Fractions	50	59	47	52
Ratio & Proportion	46	54	42	50
Per Cent	40	55	36	59
Representation of Data	57	63	55	58
Measurement (Computation)	49	60	46	55
Measurement (Other than Computation	48	54	43	51
Geometry				
Plane Figures	42	52	39	49
Coordinates	27	38	22	34
Informal Transformations	45	55	40	51
Algebra				
Integers	35	37	33	55
Formulas & Algebraic Expressions	30	42	29	40
Equations & Inequalities	41	49	49	40

The Carleton data may be worthy of attention at this point. Table 4 shows Carleton vs Ontario at the Pop A level and the pattern is very similar to the other boards. Geometry, and in particular, co-ordinates, record the lowest attainment and although the OTLs are not provided, they are available and they follow the provincial pattern. The question then arises as to why some boards take action to improve the curriculum whereas other boards do not. The Carleton rationale for inaction is reported in the first paragraph of the section labeled "Effects"in their report.

> The results were very reassuring for Carleton teachers and were an affirmation that we had a strong program. At the Board level, no changes have occurred as a result of SIMS."

There is a certain validity to the claim that the Carleton mathematics curriculum is not underachieving and hence there is no point in fixing it. On the other hand, the topic-by-topic breakdown of the data and the topic-by-topic focusing of attention could lead to changes in particular topics if change was a high priority. Until there are more data available and more cases to study, it appears that lack of curriculum change can be the result of favourable data. The point about the Carleton situation that warrants further attention is that the SIMS strategy for curriculum analysis has been sufficiently well received that it is being used in other subject areas where pools are available and it will likely be used again in mathematics as curriculum changes are entertained. Furthermore, the Carleton Board has shown that it will authorize the use of scarce resources to remedy deficits when the data confirm the case.

The boards reports up to this point have had "favourable" data to present. In other words, they can claim to be doing better than the rest of the province. It makes sense to suggest that SIMS replications would be popular under such circumstances and unpopular in situations where the board data are unfavourable. But that is what has happened in East Parry Sound and all indications suggest a positive response. The key to the success of this particular replication seems to be in the official purpose of the enterprise. It was to evaluate the mathematics curriculum in order to make improvements where the data indicated a need.

Of course, there was more to it than the statement of purpose. The coordinator responsible for the enterprise gave it a high priority and he took time to explain the whole thing, not only to the teachers and administrators, but also to the trustees. He has reported that some teachers were positive and some negative, and furthermore, that there was the same kind of split among trustees. His first stated reason for the success of the enterprise is the openness of it. There were no hidden agendas. All the

Table 4: Carleton Pop A p-values

	Average % Correct			
	Carleton (1985 - 86)		Ontario (1981 - 82)	
	Pretest	Posttest	Pretest	Postest
Estimation & Approximation	58	66	52	60
Whole Numbers	63	67	60	61
Common Fractions	54	62	51	57
Decimal Fractions	52	60	47	52
Ratio & Proportion	49	57	42	50
Per Cent	44	58	36	49
Integers	41	61	33	55
Formulas & Algebraic Expressions	35	51	29	40
Equations & Inequations	46	54	40	46
Plane Figures	47	56	39	49
Coordinates	32	46	22	34
Informal Transformations in Geometry	50	58	40	51
Representation of Data	62	69	55	58
Measurement (Computation)	53	62	46	55
Measurement (Other than Computation	50	56	43	51

stakeholders had a role to play and all wanted to get valid information about the mathematics curriculum in their schools. With this kind of feeling evident, there was no surprise then when the various reviews of the resulting data lead to curriculum change. This is a small, mostly rural board and it relies on its school principals for local leadership. The changes that have resulted from the SIMS replication are changes which the principals helped identify and now are helping to implement. The Board is solidly behind the effort and they invited Professor Merle Wahlstrom, who has been associated with SIMS from the beginning, to help them interpret the data and plan what to do. One piece of evidence that confirms the favourable attitude towards SIMS is the subsequent acceptance of an Ontario Government plan to evaluate the geography curriculum that incorporates many of the essential features of SIMS.

The Halton Roman Catholic School Board is another small board that has participated in SIMS replications. This board is interesting because it began curriculum related sample surveys in 1979 and it depended on teacher prepared items for its pool during the early years. Since 1984 the SIMS items have been used in the annual surveys and the reason that not too much is written about this operation is that the people who carry it out tend to be teaching full time and have virtually no backup suuport for research enterprises. They seem to consider this particular enterprise to be just something usefull to do.

The boards participating in the SIMS replications have had an opportunity to analyse their own efforts as well as the those of the other participating boards. Now it is evident that there are many ways to use the SIMS instruments to gather data that may be used to precipitate curriculum changes. There is no one method that is clearly preferable to all others for all boards. It is clear, however, that a type of curricular change that may be well received is easily identified with the SIMS data. The prototype

change is one that involves a topic which has a high level of intended coverage, C_I*, a low level of taught coverage, C_T†, and a low level of attained coverage, C_A‡. In classical terms, that is a topic people want taught but that has only a low OTL and low p-value. The coordinator who identified this particular type of change is B.Kelly of Halton, and he, as well as his colleagues, have labeled it a type I topic. They have defined a type II topic as well, and it possesses high C_I, high C_T, and low C_A. In other words, there is a strong wish to include the topic and a strong effort on the part of teachers to teach it, but in spite of all that there is low attainment. Such a topic needs special attention because the solution appropriate for a type I topic is not likely to work.

Plans for Change

There is variation among boards in the plans for change but there is one element in common. The variations are in the levels of organization managing the change and in the mechanisms selected to effect the change. The common element is the SIMS technology and its use in identifying the changes needed.

In the case of the first generation of change in Halton there was agreement among teachers, administration and trustees on the topic(s) needing attention. Algebra (at Pop A) was the most acute problem and it was the type I already described above. The mechanism selected to remedy the problem involved the preparation of instructional materials as well as the presentation of professional development programs for the teachers. This change activity was planned as a consequence of the first SIMS replication and the budget for it was readily passed by the Board. The planned change is now fully implemented.

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* C_I for a particular item in the approved curricular or intended curriculum is 1.0

† C_T for a particular item is the proportion of teachers teaching it.

‡ C_A for a particular item is the proportion of students passing it.

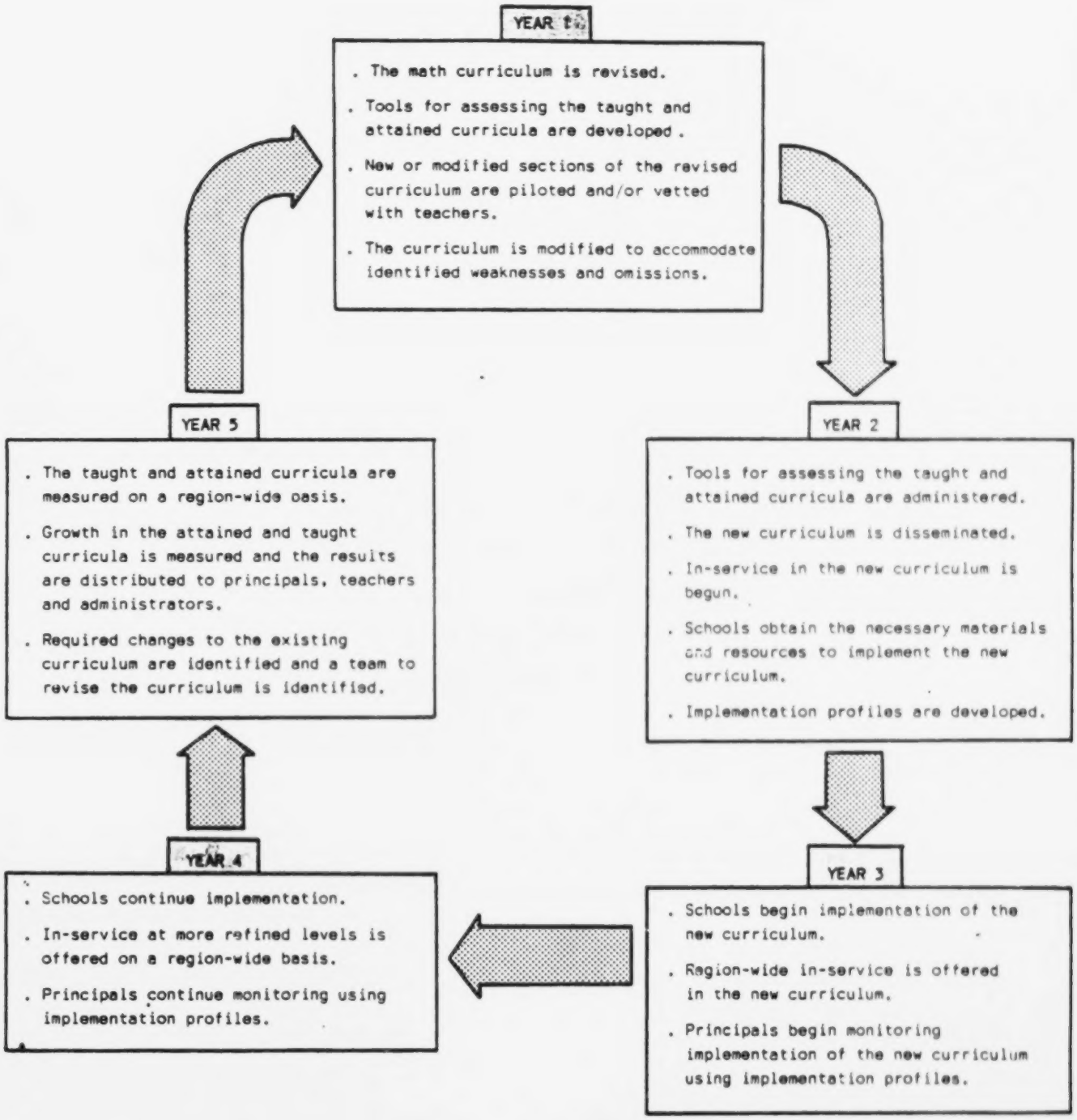
The second generation of SIMS replications has been planned and it is designed to determine the extent to which the C_T and the C_A have been raised for the target items in algebra. The key element in this second generation plan may be the most important consequence of the SIMS work in Halton. That key element is the restructuring of data gathering at the Board level so that a general sample survey is used and mathematics constitutes only one part of the substance of that survey. Furthermore, the mathematics substance is only a part of the SIMS pool. It is only that part of the pool that is related to the curriculum changes called for by the first generation data. Figure 1 is a chart from the Halton Report and it provides a general view of how data-driven curriculum change has become a fact of life in Halton. Other boards have similar plans insofar as the role of the data is concerned. They differ on the unit or level of administration that is most involved.

Summary

The participating boards of education in the enterprise known as SIMS Replications have initiated this data gathering and curriculum change activity to satisfy board level purposes. The costs of the enterprise have been borne by the boards without subsidy from external sources. The board level purposes seem to have been fulfilled at least in most instances and a continuation of the enterprise is assured as a consequence.

The context of the enterprise may be especially important to its success. The Ontario setting may be unique in that a number of school systems have had considerable experience with anonymous sample surveys of students teachers, and schools. The fundamental shift from a focus on individual student differences in total scores to a new focus on group proportions of success on particular items is well underway now but is by no means complete. It has really just begun. What Cronbach saw two decades ago as a need for new types of data to monitor curriculum change has not even begun on a large scale. But the shape of what needs to be done is beginning to emerge. It has emerged in SIMS itself and the title "The Underachieving Curriculum" is one important signal.

Figure 1: Halton


MODEL FOR CYCLIC RENEWAL AND REVISION OF THE MATHEMATICS CURRICULUM
YEAR 1
. The math curriculum is revised.
. Tools for assessing the taught and attained curricula are developed.
. New or modified sections of the revised curriculum are piloted and/or vetted with teachers.
. The curriculum is modified to accommodate identified weaknesses and omissions.
YEAR 2
. Tools for assessing the taught and attained curricula are administered.
. The new curriculum is disseminated.
. In-service in the new curriculum is begun.
. Schools obtain the necessary materials and resources to implement the new curriculum.
. Implementation profiles are developed.
YEAR 3
. Schools begin implementation of the new curriculum.
. Region-wide in-service is offered in the new curriculum.
. Principals begin monitoring implementation of the new curriculum using implementation profiles.
YEAR 4
. Schools continue implementation.
. In-service at more refined levels is offered on a region-wide basis.
. Principals continue monitoring using implementation profiles.
YEAR 5
. The taught and attained curricula are measured on a region-wide basis.
. Growth in the attained and taught curricula is measured and the results are distributed to principals, teachers and administrators.
. Required changes to the existing curriculum are identified and a team to revise the curriculum is identified.

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The SIMS replications identify some of the realities of changes that are possible when the right kind of data are gathered and analysed at a level that is close to the school and school people.

The SIMS data are really not new but there is a novel approach within SIMS and it seems to be an approach that teachers like. Whereas classical studies focused on mean scores of a system's students and on percentages of teachers for OTL, the SIMS approach aggregates student scores as attained coverage indices C_A and these indices are nothing more than classical p values. The SIMS approach aggregates OTL data into implemented coverage indices C_T (taught) which are grounded in the same test items as the C_A's or p-values. The SIMS methodology also involves an intended coverage C_I and that is essentially what in the past has been labeled the approved curriculum. Within SIMS it too is grounded in the SIMS item pool and as a consequence all three curricula can be meaningfully compared. Indeed it is the direct comparison of C_I, C_T and C_A for each item of the SIMS pool that leads to the identification of type I cases that are the prime candidates for curriculum change. The type I case has high C_I, low C_T, and low C_A. When pretest data are available as well, the type I case becomes most promising if the pre-post split is positive and relatively large. As yet, there is no clear definition of a type I case or any other case that requires attention. But there is a shared meaning for the type I case, and that sharing has lead to some very interesting curriculum changes.

The first round of data gathering in SIMS replications has produced many curriculum changes and now there is a second generation of SIMS replications underway. These tend to be focused on only that part of the curriculum that was changed, and they tend to be based on OTL and student performance. How effective these are and which ones will become most widely used is not yet clear. It does seem to be evident, however, that SIMS replications and the various generations of the replications are here to stay.